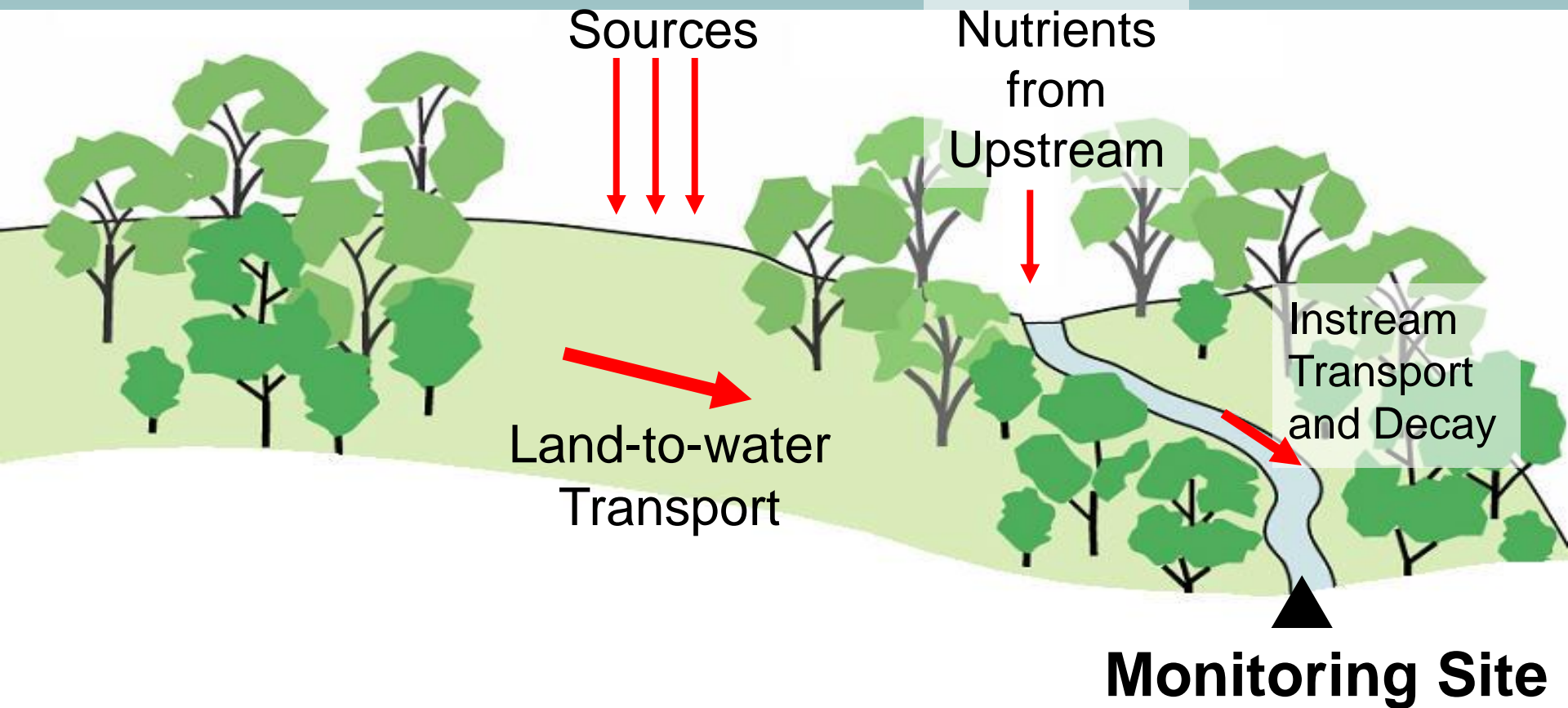




A Web-Based Tool for Evaluating Surface-Water Nutrient Conditions using the USGS SPARROW Model

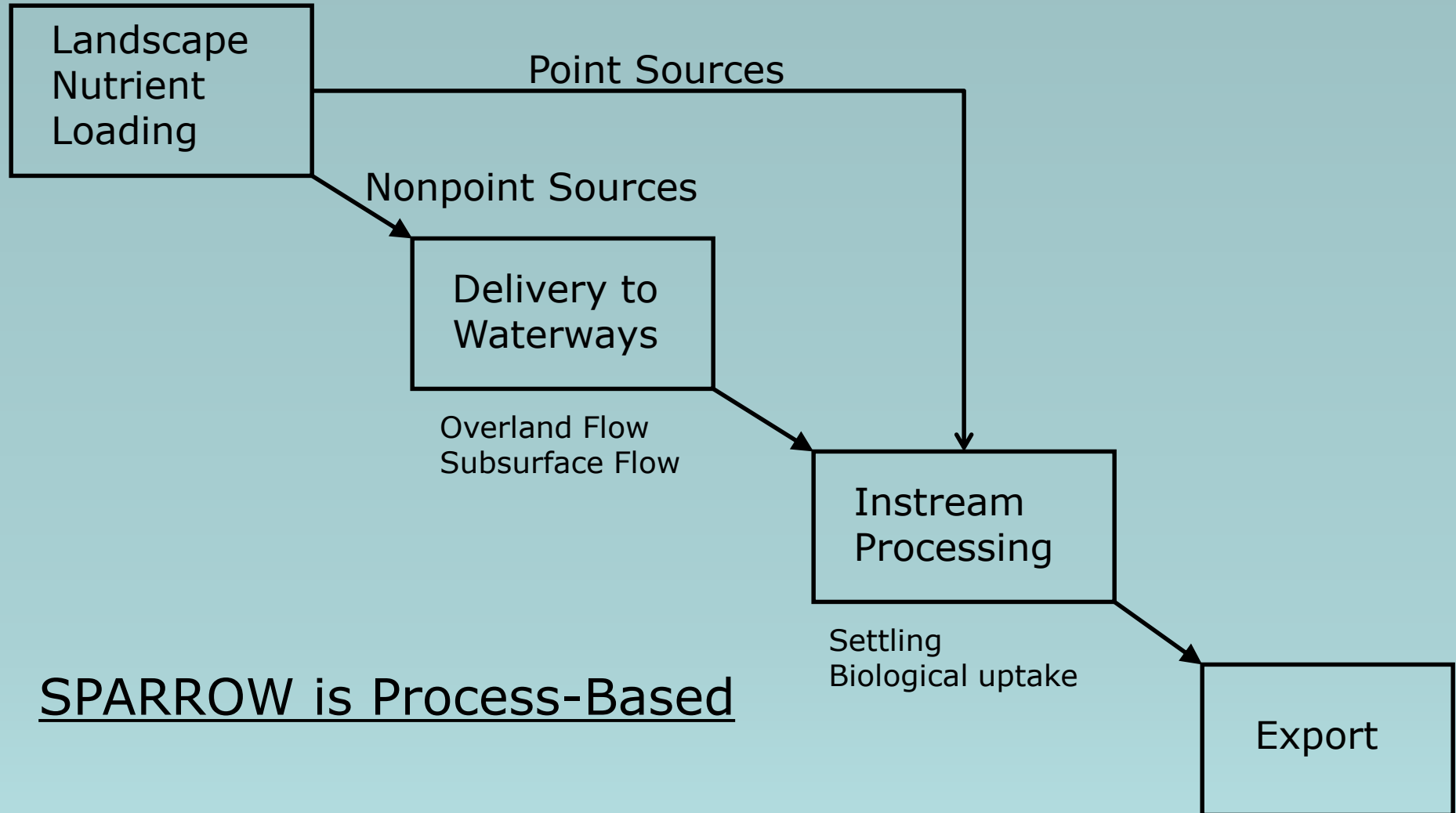
**Daniel Wise, Hydrologist
US Geological Survey
Portland, OR**

SPARROW* relates monitoring data to information on watershed characteristics and nutrient sources



*SPAtially Referenced Regressions On Watershed Attributes

SPARROW Model Description



SPARROW Model Description

SPARROW Regression Equation

$$\text{Load}_i = \left\{ \sum_{j \in J(i)} \left[\sum_{n=1}^N S_{n,j} \underbrace{\beta_n \exp(-\alpha' Z_j)}_{\text{Land-to-Water Delivery}} \right] \underbrace{\exp(-\delta' T_{i,j})}_{\text{Instream Processing}} \right\} \underbrace{\exp(\epsilon_i)}_{\text{Error}}$$

Sources

Land-to-Water
Delivery

Instream
Processing

Error

SPARROW Predictions are Statistically Derived

SPARROW extrapolates calibration results for monitored watersheds to all locations throughout a region



Nutrient Sources Explicitly Considered in the Pacific Northwest SPARROW Models

Point Sources

WWTP's

Fish Hatcheries

Industrial Facilities

Nonpoint Sources

Farm Fertilizer

Livestock Waste

Developed Land (mostly fertilizer)

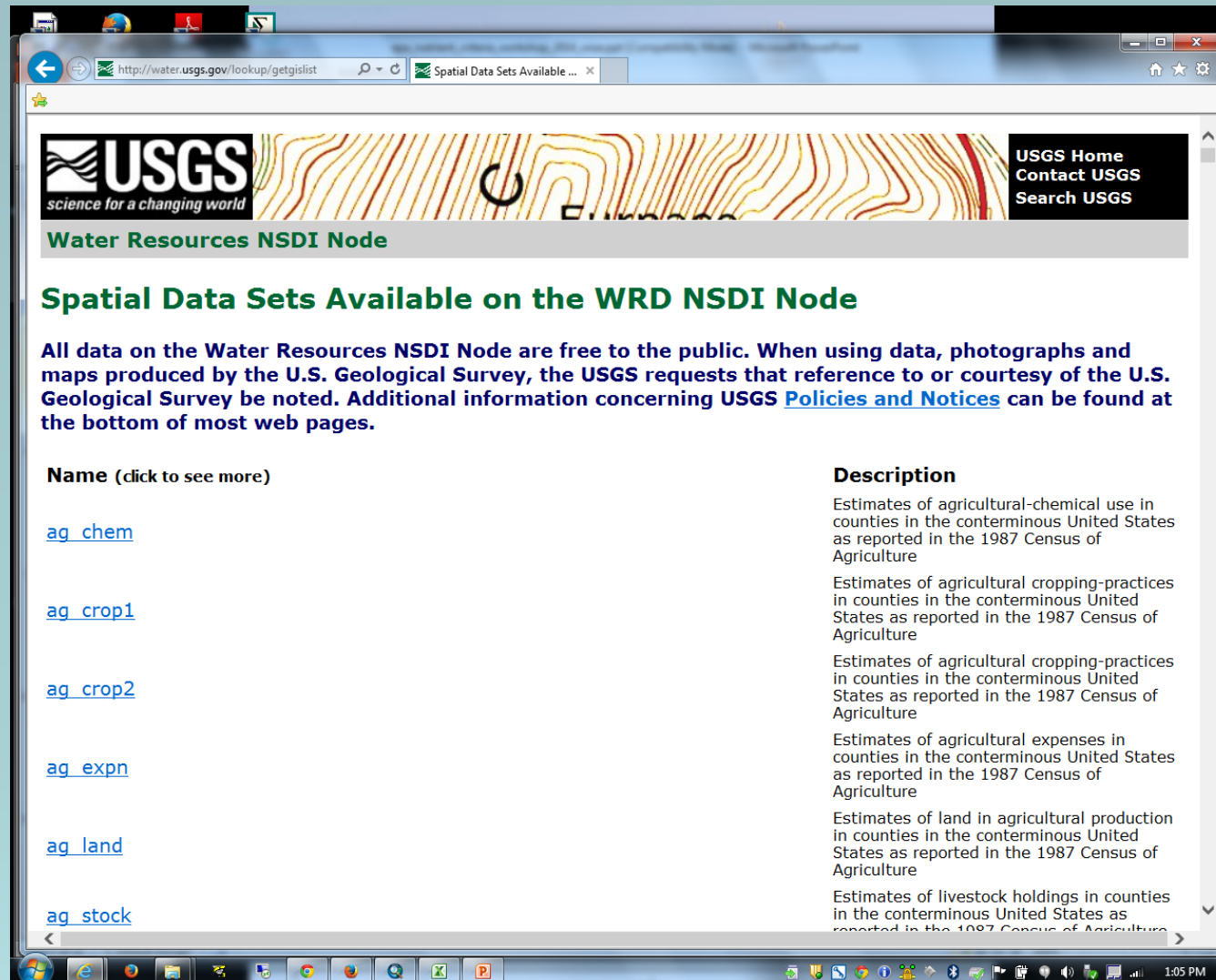
Atmospheric N Deposition

Forest Land (N fixation)

Red Alder Trees (N fixation)

Geologic Phosphorus

Nutrient Sources Explicitly Considered in the Pacific Northwest SPARROW Models

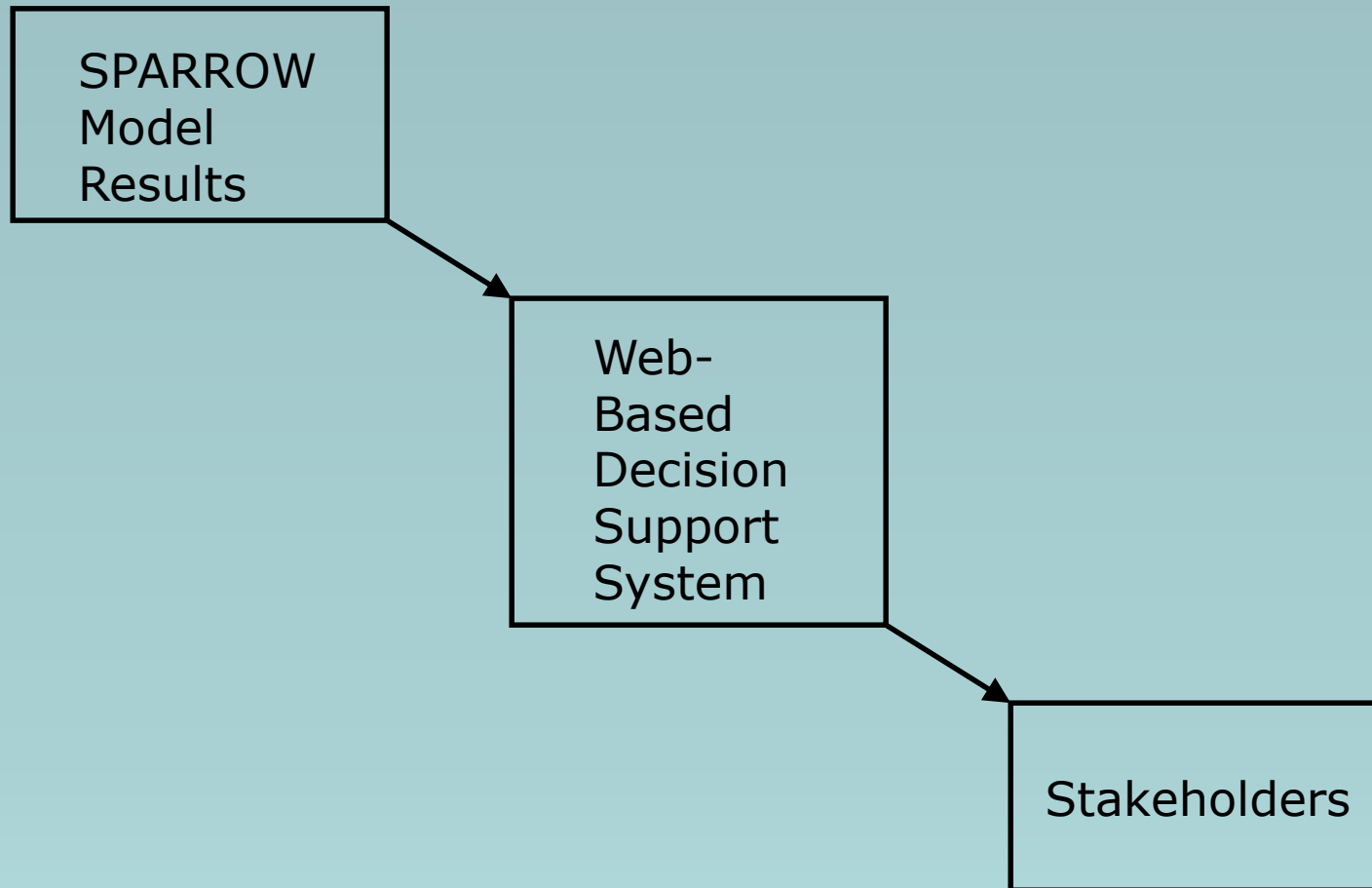


The screenshot shows a web browser window displaying the USGS Water Resources NSDI Node. The page features the USGS logo and a topographic map background. A navigation bar includes links for 'USGS Home', 'Contact USGS', and 'Search USGS'. The main heading is 'Spatial Data Sets Available on the WRD NSDI Node'. Below this, a paragraph states that all data is free to the public and provides a link to USGS Policies and Notices. A table lists various spatial data sets with their names and descriptions.

Name (click to see more)	Description
ag_chem	Estimates of agricultural-chemical use in counties in the conterminous United States as reported in the 1987 Census of Agriculture
ag_crop1	Estimates of agricultural cropping-practices in counties in the conterminous United States as reported in the 1987 Census of Agriculture
ag_crop2	Estimates of agricultural cropping-practices in counties in the conterminous United States as reported in the 1987 Census of Agriculture
ag_expn	Estimates of agricultural expenses in counties in the conterminous United States as reported in the 1987 Census of Agriculture
ag_land	Estimates of land in agricultural production in counties in the conterminous United States as reported in the 1987 Census of Agriculture
ag_stock	Estimates of livestock holdings in counties in the conterminous United States as reported in the 1987 Census of Agriculture

Nutrient sources and other landscape data available in raster and vector format from USGS WRD NSDI Node

SPARROW Decision Support System



SPARROW Decision Support System

- **Predict water-quality conditions where no water-quality data are available**
- **Predict contaminant delivery by source type and location**
- **Predict changes in water-quality conditions under different management scenarios**

SPARROW Decision Support System

SPARROW Decision Support System - Windows Internet Explorer

http://cida.usgs.gov/sparrow/#modelid=43

File Edit View Favorites Tools Help

★ Favorites SPARROW Decision Support System

USGS
science for a changing world

SPARROW Decision Support System

Find a Model by Geographic Location:
Select a region or state. When a state is selected, all models containing that state are listed.



Any Region or State

Find a Model by Modeled Constituent:
Any

Models matching your criteria (click a model to show details)

- National Suspended Sediment Model - 1992
- National Total Nitrogen Model - 1992
- National Total Phosphorus Model - 1992
- Total Dissolved Solids Model for the Rio Grande, Colorado, and Great Basin Region - 2006

Documentation and Further Reading

- What is SPARROW?
- What is SPARROW Decision Support?
- SPARROW Applications & Documentation
- SPARROW FAQs

Tutorial Videos

Select a video... Watch now >>

Found a bug or have a comment?
Please send bugs, suggestions and questions to the [SPARROW Decision Support System Administrator](#).

Selected Model

2002 Total Nitrogen Model for the U.S. Pacific Northwest



Explore this model in the Decision Support System >>

Modeled Constituent: Nitrogen
Base Year: 2002
Stream Network: Enhanced River Reach File 2.0
Reference: Surface-Water Nutrient Conditions and Sources in the United States Pacific Northwest

Watershed Based Sessions
To start the DSS with the outlet river reach of a major watershed selected for downstream tracking, select a watershed and click Go.

Snake River Headwaters Watershed Go >>

Scenario Based Sessions
To start the DSS with a predefined scenario, click on the link for one of the scenarios below.

Done

Slide 20 of 22 1 - Default Design

start Windows Ex... Mail - Inbox - IB... SAS

Local intranet 100%

1:20 PM

<http://water.usgs.gov/nawqa/sparrow/dss>

SPARROW Decision Support System

SPARROW Decision Support System - Windows Internet Explorer

http://cida.usgs.gov/sparrow/#modelid=43

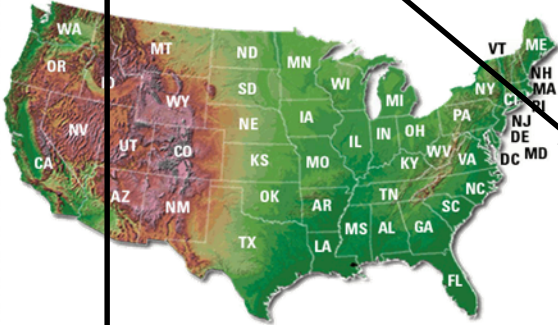
File Edit View Favorites Tools Help

USGS science for a changing world

Select an application – TN or TP; Region

SPARROW Decision Support System

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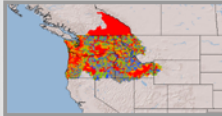
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Done

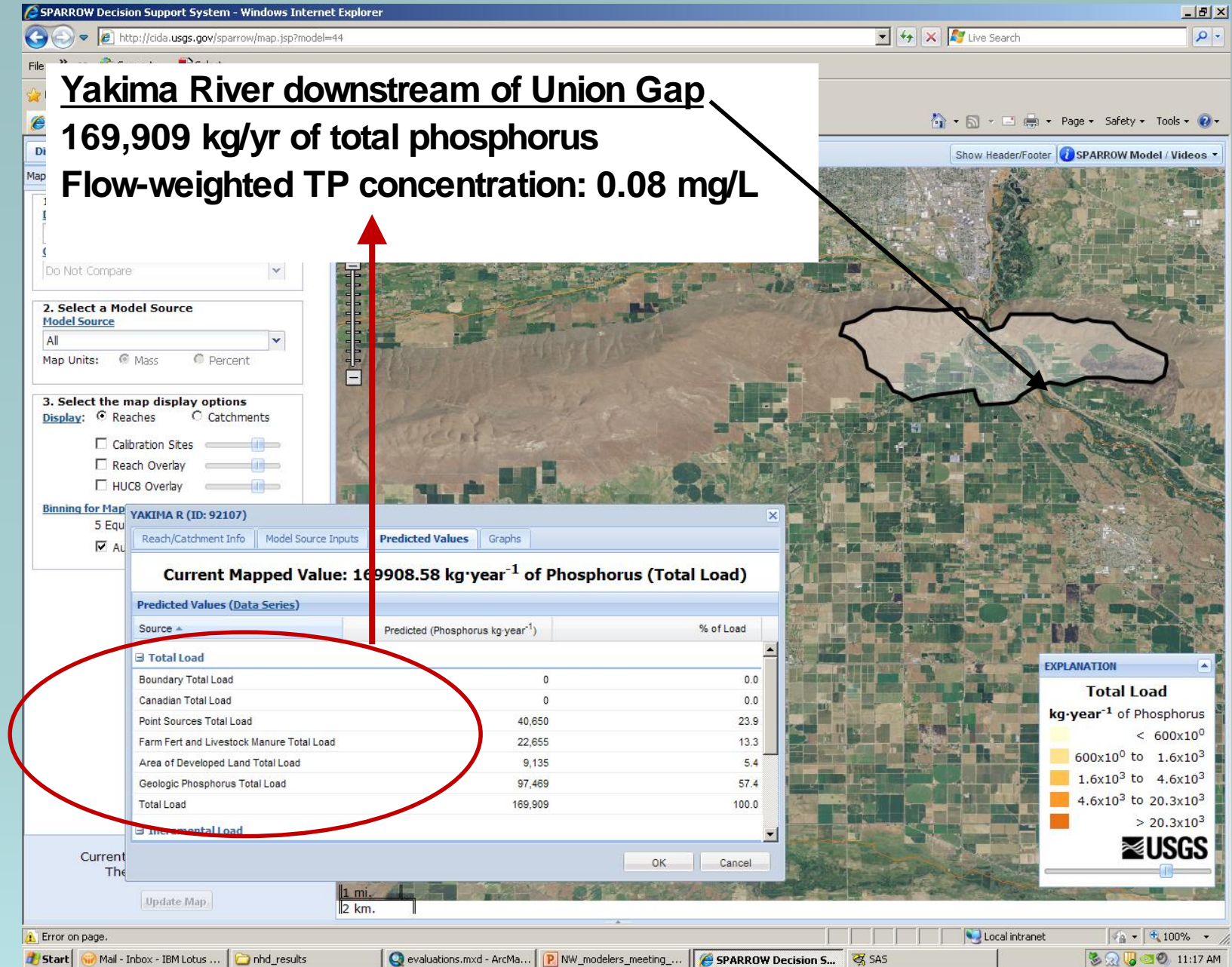
Slide 20 of 22 1-Default Design

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SPARROW Decision Support System

- **Predict water-quality conditions where no water-quality data are available**
- **Predict contaminant delivery by source type and location**
- **Predict changes in water-quality conditions under different management scenarios**

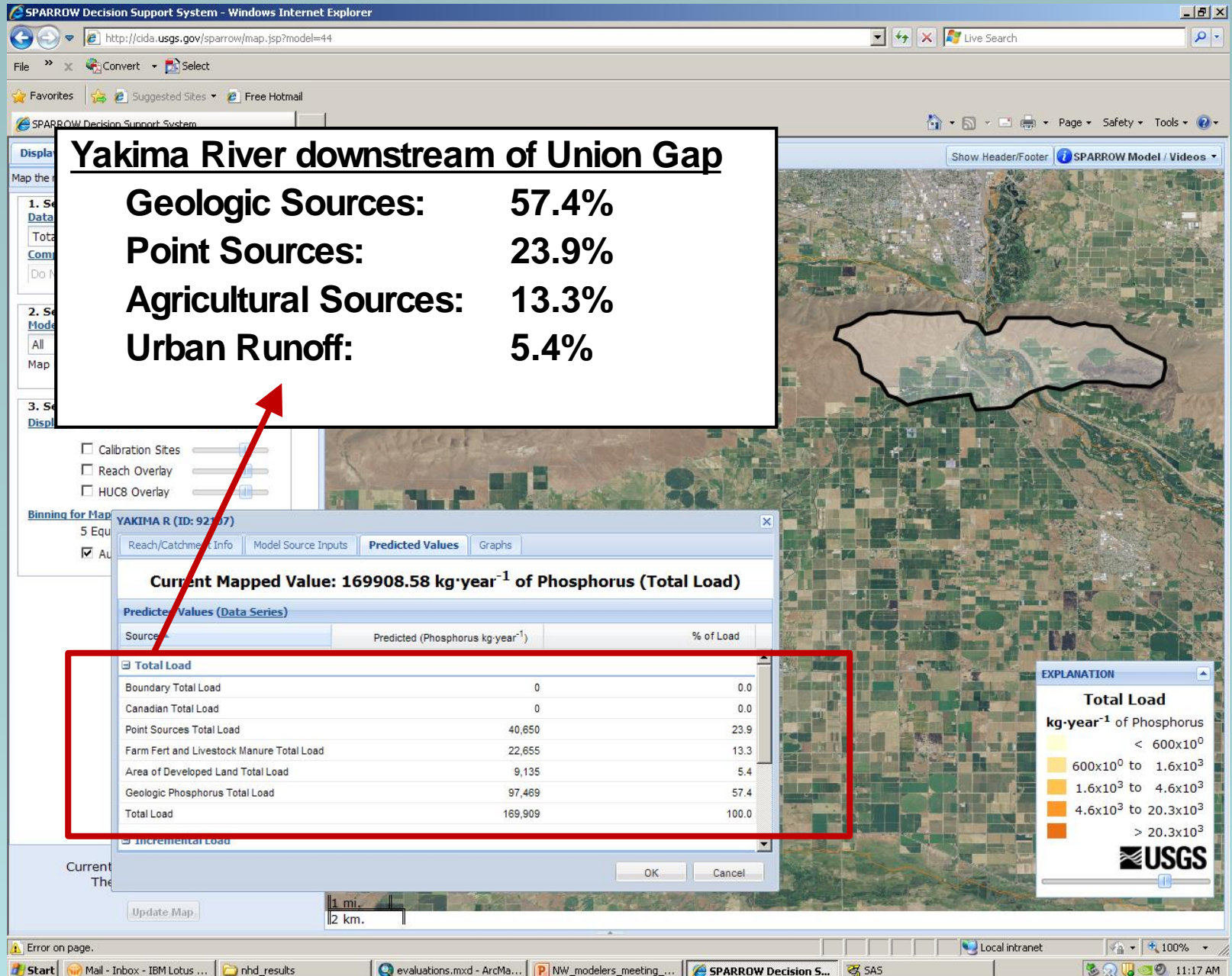
Predicting Water-Quality Conditions



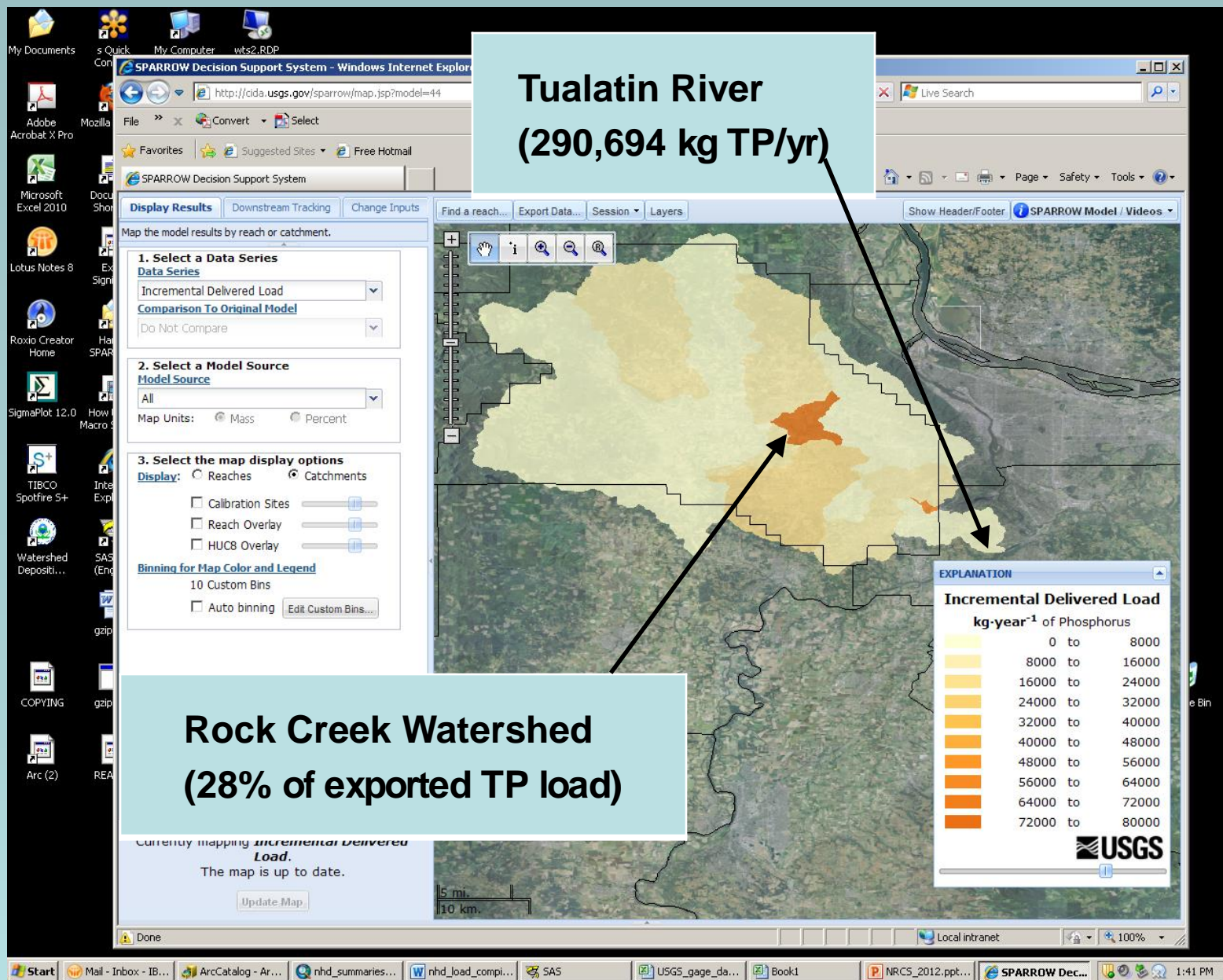
SPARROW Decision Support System

- Predict water-quality conditions where no water-quality data are available
- **Predict contaminant delivery by source type and location**
- Predict changes in water-quality conditions under different management scenarios

Predicting Water-Quality Conditions



Delivery to Downstream Waters



SPARROW Decision Support System

- **Predict water-quality conditions where no water-quality data are available**
- **Predict contaminant delivery by source type and location**
- **Predict changes in water-quality conditions under different management scenarios**

Running Management Scenarios

SPARROW Decision Support System - Windows Internet Explorer

http://cida.usgs.gov/sparrow/map.jsp?model=44

File » x Convert Select

Favorites Suggested Sites Free Hotmail

SPARROW Decision Support System

Display Results Downstream Tracking **Change Inputs** Find a reach... Export Data... Session Layers Show Header/Footer SPARROW Model / Videos

Map the effect of management scenarios on stream water quality, based on hypothetical information, [click here](#).

1. Select stream reach changes will be applied
 --Locate on map 'i'
 --Find by name or I
Reach Name: YAKI
 Choose a group from select what set of reach group can be created directly in the dropdown
 Type group name
☒ This reach only.
☐ Reaches upstream
☐ Reaches in HUC 8
17030003
☐ Reaches in HUC 6 : YAKIMA : 170300
☐ Reaches in HUC 4 : YAKIMA : 1703
☐ Reaches in HUC 2 : PACIFIC
NORTHWEST : 17

2. Change the values of the source inputs
 (Right click to change input values or show on map)
 yakima
 upstream of 92107 (REACH:92107)

3. Display Results
 From the **Display Results** tab, select a data series.
 (Map relative or absolute changes using the **Comparison to Original Model** feature)

Currently mapping **Total Load**.
 The map is up to date.

Update Map

Yakima River below Union Gap
50% Reduction in Upstream Point Source Loading to Streams
Adjusted TP Load 149,584 kg/yr (-12%)

YAKIMA R (ID: 92107)

Reach/Catchment Info Model Source Inputs **Predicted Values** Graphs

Current Mapped Value: 149583.73 kg·year⁻¹ of Phosphorus (Total Load)

Predicted Values (Data Series)

Source	Original (Phosphorus kg·year ⁻¹)	% of Load (Original)	Adjusted (Phosphorus kg·year ⁻¹)	% of Load (Adjusted)	% Change
Total Load					
Boundary Total Load	0	0.0	0	0.0	0
Canadian Total Load	0	0.0	0	0.0	0
Point Sources Total Load	49,650	23.0	20,325	13.3	-50
Farm Fert and Livestock ...	22,655	13.3	22,655	15.1	0
Area of Developed Land ...	9,135	5.4	9,135	6.1	0
Geologic Phosphorus Tot...	97,469	57.4	97,469	65.2	0
Total Load	169,909	100.0	149,584	100.0	-12
Incremental Load					
Boundary Incremental Lo...	0	0.0	0	0.0	0

OK Cancel

EXPLANATION

Total Load
 kg·year⁻¹ of Phosphorus

< 600x10⁰
 600x10⁰ to 1.6x10³
 1.6x10³ to 4.6x10³
 4.6x10³ to 20.3x10³
 > 20.3x10³

USGS

12 km.

Error on page.

Start Mail - Inbox - IBM Lotus ... nhd_results evaluations.mxd - ArcMa... NW_modelers_meeting... SPARROW Decision S... SAS

Local intranet 100% 11:29 AM

Running Management Scenarios

SPARROW Decision Support System - Windows Internet Explorer

http://cida.usgs.gov/sparrow/map.jsp?model=44

File » X Convert Select

Favorites Suggested Sites Free Hotmail

SPARROW Decision

Display Results

Map the effect of man...
quality, based on hypo...
information, click her...

1. Select stream...
changes will be...
--Locate on ma...
--Find by name...
Reach Name: Y...
Choose a group...
select what set o...
group can be cre...
directly in the dr...
Type group nam...
☒ This reach or...
☐ Reaches up...
☐ Reaches in H...
17030003
☐ Reaches in H...
☐ Reaches in H...
☐ Reaches in H...
NORTHWEST : J

2. Change the v...
(Right click to change input values or s...
map)
Yakima
upstream of 92107 (REACH:92107)

3. Display Results
From the **Display Results** tab, select...
series.
(Map relative or absolute changes usi...
Comparison to Original Model feat...

Currently mapping **Concentr...**
The map is up to date

Update Map

Reach/Catchment Info Model Source Inputs **Predicted Values** Graphs

Current Mapped Value: 0.03 mg/L of Phosphorus (Concentration)

Predicted Values (Data Series)

Source	Original (Phosphorus kg...	% of Load (Ori...	Adjusted (Phosphorus kg...	% of Load (Adj.)	% Change
Total Load					
Boundary Total Load	0	0.0	0	0.0	0
Canadian Total Load	0	0.0	0	0.0	0
Point Sources Total Load	40,650	23.9	0	0.0	-100
Farm Fert and Livestock ...	22,655	13.3	0	0.0	-100
Area of Developed Land...	9,135	5.4	0	0.0	-100
Geologic Phosphorus Tot...	97,469	57.4	97,469	100.0	0
Total Load	169,909	100.0	97,469	100.0	-43
Incremental Load					
Boundary Incremental Load	0	0.0	0	0.0	0

OK Cancel

Yakima River below Union Gap
No Upstream Anthropogenic Sources

Adjusted TP Load 97,469 kg/yr (-43%)

Adjusted Flow-Weighted TP Concentration 0.03 mg/l

Recommended EPA TP Reference Criteria 0.022 mg/l

SPARROW Model / Videos

Show Header/Footer

EXPLANATION

Concentration
mg·L⁻¹ of Phosphorus

<0.01 (non-detect)

0.01 to 0.03

0.03 to 0.04

0.04 to 0.06

0.06 to 0.10

> 0.10

USGS

Done, but with errors on page.

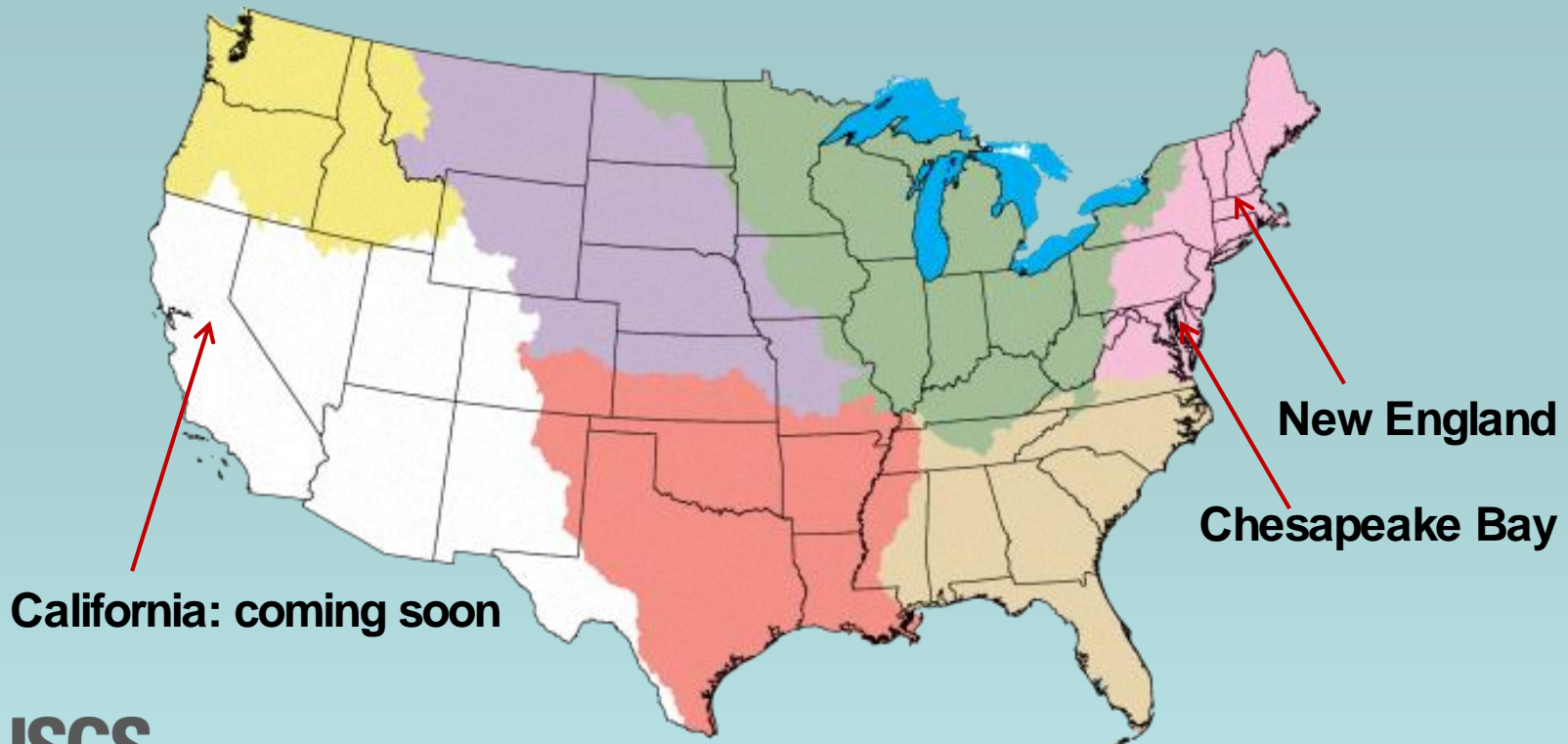
Start Mail - Inbox - IBM Lotus ... SAS nhd_results NW_modelers_meeting... SPARROW Decision S...

Local intranet 100%

10:26 AM

Other SPARROW Nutrient Models

- United States National Models
- U.S. Major River Basins



How can I get more information?

- SPARROW Information:

<http://water.usgs.gov/nawqa/sparrow/>

- PNW Regional Models:

<http://water.usgs.gov/nawqa/sparrow/mrb/7.html>

- Decision Support System

<http://water.usgs.gov/nawqa/sparrow/dss/>

- Contact:

Daniel Wise (dawise@usgs.gov)

503-251-3213